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FISH MEAL AS A FEED FOR SWINE.[1]

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INTRODUCTION.

Heretofore feeds and labor have been so abundant and have been available at such moderate prices that close calculation in their use has been unnecessary. The present war has caused the American farmer to make a closer study of the economics of the national feed situation than ever before. If a large part of the corn, wheat, barley, and similar carbonaceous grains must be saved for human consumption, then farmers who raise and fatten live stock will have to practice stricter economy in their feeding operations.

The hog is a heavy and promiscuous feeder. He is not a ranger and does not thrive on pasture alone. The grain fed to swine, however, can be reduced greatly by making wider use of nitrogenous feeds. Since the feeding stuffs of high protein content are already in great demand, now is the time to call upon the reserve supply of protein furnished by waste fish and by the waste from fish-canning industries. Many years ago attention was called to the possibilities of fish meal as a feeding stuff, both in this country and abroad, and it is indeed surprising that its use as a feed for stock has not been fostered in this country.

[1] The fish meal used in these experiments was made under the direction of Dr. F. C. Weber, Chemist in Charge, Animal Physiological Chemical Laboratory, Bureau of Chemistry. Acknowledgment is here made for his interest and cooperation, which made the experiments with fish meal possible.

Fish meal and fish scrap, or "pomace," are similar in composition, the former, however, being prepared for use as a feeding stuff and the latter as a fertilizer. In the manufacture of fertilizer the object is merely to produce a material that contains one or more of the following necessary constituents: Nitrogen, phosphate, or potash. In the case of fish meal, being a feed stuff, the material from which it is made must be fresh, wholesome, and nutritious, and greater care must be taken in the manufacture.

The Norwegian Government in 1892 conducted a series of feeding experiments with fish meal and obtained very favorable results. Since then the merits of fish meal have been more and more appreciated in Germany, especially as a feeding stuff for pigs. For some years prior to the present war Germany not only used up all it could produce, but took all that England and Norway had to offer. In the United States fish meal as a feeding stuff has been neglected in spite of the proof of its value.

USE OF FISH MEAL IN THE UNITED STATES.

The amount of fish meal used for feeding purposes in this country is so small compared with other materials used as feeding stuff that it is hardly worth mentioning. Although of great use as a fertilizer, the product is clearly of more value to the country as a feeding stuff. English experiments have shown that the oil, which in many samples of fish meal ranges from 7 to 10 per cent, is distinctly disadvantageous in preventing the manure from rotting in the soil and yielding up its nitrogen to the crop. The oil itself contributes nothing to the value of the manure and is simply wasted when applied to the land. There is every reason to favor the view that fish meal should not be spread on the land until it has been passed through the digestive apparatus of farm stock.

Very little has been done to bring the value of fish meal before the agriculturist in this country. It is to be regretted that the American farmer has not been brought to appreciate the true value of fish meal.

Probably one of the reasons for fish meal having been thus neglected is the impression that if it is used in the feeding of animals, their flesh will become tainted. This belief is entirely unwarranted, as shown by German, English, and American experiments, and will be pointed out later in connection with our own experiments. If, as reported, some farmers who have tried it have not found fish meal satisfactory as a feeding stuff, it is because they have not used it with understanding. Fish meal is very similar to packing-house tankage in composition and can be fed in exactly the same proportions. If moderate proportions are fed in combination with carbonaceous feeds, its efficiency as a feeding stuff soon will become apparent.

FEEDING EXPERIMENTS WITH PIGS.

Two feeding trials were conducted at the Bureau of Animal Industry Experimental Farm, Beltsville, Md., to determine the value of fish meal as a feed for pigs.

1. COMPARISON OF FISH MEAL AND TANKAGE AS SUPPLEMENTARY FEEDS.

The first experiment was conducted to determine the comparative values of fish meal and tankage as supplements in a ration for growing and fattening pigs. The pigs used in this work were grade Berkshires, averaging 52.3 pounds per head when the experiment started. They were as uniform in size, age, and breeding as it was possible to obtain.

The guaranteed analysis of the tankage was:

	Per cent.
Protein	60
Fat	8
Phosphoric acid	8
Crude fiber	3

The analysis of fish meal was:

Water	6.36
Fat	15.34
Protein (N × 6.25)	57.31
Ash	16.52
Undetermined	4.47

The feeding period was divided into two parts: First, a growing period of 112 days from weaning up to fattening age, starting January 19, 1915, and ending May 11, 1915; second, a fattening period of about one month, starting May 11, 1915, and ending June 8, 1915. The pigs at this date averaged a little more than 250 pounds and were sold. During the first period the pigs were divided into two lots of 8 and 4; during the second, or fattening, period they were divided into three lots of 4. Details and results of the feeding are given below.

RESULTS DURING THE GROWING PERIOD.

The pigs, which were all in good, thrifty, growing condition, were about 3 months of age at the beginning of the experiment, and in order to accustom them to their surroundings they were fed in dry lot from the time they were weaned until the experiment was begun. The pigs in both lots were so fed that all the feed, which was in the form of a thin slop, was cleaned up at each feeding, thereby insuring a sharp appetite at the next feeding time. There was no trouble whatever in getting the pigs to eat the ration containing fish meal.

Summary of results during growing period, Jan. 19, 1915, to May 11, 1915 (112 days).

Lot 1. Ration: 4 parts corn meal, 4 parts middlings, 1 part tankage:		
Duration of experiment	days	112
Pigs	number	8
Average first weight	pounds	51.37
Average final weight	do	191.50
Average gain per pig	do	140.13
Daily gain per pig	do	1.25
Total grain fed	do	4,060.5
Average grain eaten per pig daily	do	4.53
Grain per 100 pounds gain	do	362
Lot 2. Ration: 4 parts corn meal, 4 parts middlings, 1 part fish meal:		
Duration of experiment	days	112
Pigs	number	4
Average first weight	pounds	54.25
Average final weight	do	201.50
Average gain per pig	do	147.25
Daily gain per pig	do	1.31
Total grain fed	do	2,152.5
Average grain eaten per pig daily	do	4.80
Grain per 100 pounds gain	do	365

During the growing period Lot 2, fed corn meal, middlings, and fish meal, made a greater daily gain than Lot 1, receiving the tankage supplement. The lot receiving the fish-meal supplement consumed 122.3 pounds more feed and gained a total of 28.5 pounds more in weight than did an equal number of Lot 1 receiving tankage. At the close of the growing period the average weight of the pigs fed fish meal was 201.5 pounds and that for the pigs getting the tankage supplement was 191.5 pounds, a difference of 10 pounds. From observation no difference could be noted between the two lots with respect to growth or general development. This would indicate that one ration was not particularly superior to the other in meeting requirements for growth in pigs.

RESULTS DURING THE FINISHING PERIOD.

The same 12 pigs were used for the second period and were divided into three lots and fed as follows:

Lot 3, composed of the same 4 pigs as Lot 2 in the growing period, was continued on the same ration, namely, 4 parts of corn meal, 4 parts of middlings, and 1 part of fish meal.

Lot 4, composed of 4 pigs from Lot 1, was fed a ration of 9 parts of corn meal and 1 part of fish meal.

Lot 5, composed of the remaining 4 pigs from Lot 1, was fed a ration of 9 parts of corn meal and 1 part of tankage.

Many farmers feed the same ration for both the growing and fattening periods, and the intention was to carry out this scheme

with this lot of hogs in order to determine the advisability of the practice.

Summary of results during fattening period, May 11, 1915, to June 8, 1915 (28 days).

Lot 3. Ration: 4 parts corn meal, 4 parts middlings, 1 part fish meal.		
Duration of experiment	days	28
Pigs	number	4
Average first weight	pounds	201.5
Average final weight	do	255.25
Average gain per pig	do	53.75
Daily gain per pig	do	1.91
Total grain fed	do	903.00
Average grain eaten per pig daily	do	8.06
Grain per 100 pounds gain	do	421.00
Lot 4. Ration: 9 parts corn meal, 1 part fish meal.		
Duration of experiment	days	28
Pigs	number	4
Average first weight	pounds	191.5
Average final weight	do	251.75
Average gain per pig	do	60.25
Daily gain per pig	do	2.16
Total grain fed	do	956.00
Average grain eaten per pig daily	do	8.54
Grain per 100 pounds gain	do	393.00
Lot 5. Ration: 9 parts corn meal, 1 part tankage.		
Duration of experiment	days	28
Pigs	number	4
Average first weight	pounds	192.00
Average final weight	do	248.00
Average gain per pig	do	54.00
Daily gain per pig	do	2.00
Total grain fed	do	910.00
Average grain eaten per pig daily	do	8.13
Grain per 100 pounds gain	do	462.00

The lot fed corn meal, middlings, and fish meal during the finishing period did not consume as much feed as the lot fed corn meal and fish meal or the lot fed corn meal and tankage. The lot fed 9 parts of corn meal and 1 part of fish meal made a better showing than either of the other lots in the rate of gain and pounds of feed fed per 100 pounds gain.

2. FISH MEAL AS A SUPPLEMENT TO DRIED POTATO.

The second experiment was conducted primarily to determine the value of dried pressed potato in a ration for fattening hogs when supplemented by feeds rich in protein. The results show conclusively that fish meal is an outstanding protein supplement to feed along with potatoes.

This experiment was started September 12, 1916, and continued 56 days, ending November 7, 1916. Twelve high-grade Berkshire pigs between 5 and 6 months of age, averaging approximately 150 pounds in weight, were used in this work. Those selected were very uniform in age, quality, breeding, and weight. The pigs were taken off pasture and put in the dry lot a week before the experiment proper began. They were confined in a permanent hog house and arranged into 4 lots of 3 pigs each. The pens used for each lot measure 6 feet by 7½ feet, and have cork-brick floors. Attached to these pens are outside runs of concrete 7 feet by 39 feet. Prior to the experiment the pigs were fed a ration of 5 parts corn meal, 4 parts middlings, and 1 part tankage. The experimental rations were as follows:

Lot 1 (check lot), 6 parts corn meal, 1 part tankage.

Lot 2, 6 parts dried pressed potato, 1 part tankage.

Lot 3, 6 parts dried pressed potato, 1 part linseed oil meal (old process).

Lot 4, 6 parts dried pressed potato, 1 part fish meal.

Following are the analyses of the dried pressed potato rations as made by the Bureau of Chemistry, Department of Agriculture:

Analyses of dried pressed potato ration.

Ration.	Moisture.	Ash.	Ether extract.	Protein.	Crude fiber.	Nitrogen-free extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Dried pressed potato and tankage	11.83	3.04	0.80	11.03	2.29	71.01
Dried pressed potato and oil meal	11.91	1.65	.67	5.96	2.98	76.83
Dried pressed potato and fish meal	10.96	4.04	2.87	13.09	1.85	67.19

The lots were fed three times daily (7 a. m., 11.30 a. m., and 4.30 p. m.). For each meal the feed for each lot was weighed and put into a bucket with enough water to make a thick slop. The feed was mixed with water one-half hour before feeding, so as to allow it to soak. Just after the feed was mixed live steam was turned into each bucket of feed for a few minutes to facilitate soaking. A fresh supply of water was given to the pigs about the middle of the forenoon. The hogs were weighed on the scales located inside the permanent hog house; the weighing was done about 9.30 a. m. Individual weights were taken for three consecutive days (one day previous to the beginning of the experiment and each of the first two days of the experiment). The average of the three weights was taken as the weight of the second day or the beginning of the experiment. Individual weights were taken every Tuesday thereafter until the conclusion of the experiment.

RESULTS OF THE FEEDING.

The pigs in all the lots ate well and regularly and not one of them went off feed during the test. Small quantities of feed were left in the troughs after feeding time, but this was due to the fact that the pigs were required to eat a little more than they conveniently could handle. Dried pressed potato is rather bulky, and it is difficult to determine the amount that will be cleaned up by the pigs at one feed. All the pigs in the experiment were fed 2 pounds of feed per head per day at the beginning of the test. This, of course, was a very small quantity for 150-pound pigs, but they were given this small portion at first because by gradually starting pigs on a feed the appetite is kept keen and the chances of going off feed are very much lessened. The pigs also are better enabled to cultivate an appetite for a new feed.

Summary of results, fattening period, September 12 to November 7, 1916 (56 days).

	Lot 1, 6 parts corn meal, 1 part tankage.	Lot 2, 6 parts dried pressed potato, 1 part tankage.	Lot 3, 6 parts dried pressed potato 1 part oil meal.	Lot 4, 6 parts dried pressed potato, 1 part fish meal.
Number of pigs	3	3	3	3
Average first weight.....pounds..	153.33	153.33	150.00	154.33
Average final weight.....do....	242	198.33	206.33	228.66
Average gain per pig.....do....	87.77	45.00	51.33	74.33
Average daily gain.....do....	1.57	.80	.91	1.32
Total grain fed.....do....	1,072	939	900.5	956.5
Pounds fed per 100 pounds gain.....do....	403	695	584	428
Daily feed per 100 pounds, live weight.....do....	3.23	3.16	2.93	2.91
Average daily feed.....do....	6.4	5.5	5.3	5.7

All the pigs were in good, thrifty, growing condition at the beginning, and were maintained in good condition and health during the progress of the experiment. A study of the table will show that Lot 1 (check) excelled all the other lots with respect to rate of gains, amount of feed consumed to produce 100 pounds of gain, and the average final weight. This lot of pigs was the largest and growthiest in the experiment. They were heavy feeders and returned good gains for the amount of feed consumed.

The lot receiving dried pressed potato and fish meal (Lot 4) was a very close second to the check lot. The figures, however, show greater advantages in favor of the check lot than one could detect with the eye. Both these lots maintained good condition throughout the experiment and carried a very high degree of finish. There was a difference of 13 pounds per hog in favor of the check lot at the close of the test. The pigs in Lot 4 were evidently as heavy feeders as those in the check lot, but it is impossible for pigs to consume

very large amounts of the dried pressed potato on account of the bulkiness of this feed. The pigs receiving dried pressed potato and fish meal consumed a daily ration of 5.7 pounds, made a daily gain of 1.32 pounds, and required 428 pounds of feed to produce 100 pounds of gain.

The pigs in Lot 3, receiving dried pressed potato and oil meal, consumed less feed than any other lot in the experiment. From this, one might infer that the ration was the least palatable and least efficient of any of the rations fed. This, however, is not true, because the pigs in Lot 2, receiving dried pressed potato and tankage, ate more feed than Lot 3, although they made smaller gains. This tends to prove that the potato ration containing oil meal is more efficient in producing gains than the potato ration containing tankage, although the pigs ate less of the potato and oil-meal feed. The pigs in Lot 3 had a higher degree of finish than the potato and tankage pigs (Lot 2), but they were not equal to the potato and fish-meal pigs in this respect. The pigs in Lot 3 consumed a daily ration of 5.3 pounds, made a daily gain of 0.91 pound, and required 584 pounds of feed to produce 100 pounds of gain.

The pigs in lot 2, which were fed dried pressed potato and tankage, consumed enough feed to put them in higher condition than they had at the close of the feeding test. The showing that these pigs made can not be called poor, but it is evident that tankage is not as efficient as a protein supplement to use with dried pressed potato as fish meal or even old-process linseed-oil meal. The pigs in lot 2 returned a smaller amount of gain for the amount of feed consumed than any other lot in the experiment. These pigs consumed an average daily ration of 5.5 pounds, made an average daily gain of 0.80 of a pound, and required 695 pounds of feed to put on 100 pounds of gain.

CARCASS TEST.

At the close of both these experiments the heaviest hog was selected from each lot and slaughtered on the farm to determine the quality of flesh and fat and the degree of finish. The carcasses were divided into regular meat cuts in as nearly uniform a manner as possible. The fresh pork from each hog was eaten by individuals who were ignorant of the feed that the hogs received, in order to test the flavor and cooking qualities of the meat. The lard fat was cut from the trimmings and rendered, as was also the fat from the carcass, and observations upon them were made. In no case was the meat reported as having a fishy odor or taste. If the carcass had been tainted from feeding fish meal, it would most certainly have been evident in the rendering of the lard, but such was not the case.

The results of this work, and also the successful use of fish meal as a feeding stuff in Germany, show that the belief that the consumption of this product taints the meat is unwarranted.

CONCLUSION.

Fish meal is a very effective supplement to a grain ration for pigs. The animals relish it and are extremely fond of it. Fish meal was superior to tankage in all comparisons, although the daily gains in all cases were exceptionally good. The pigs maintained a thrifty growth and were never off their feed during the entire feeding period. Fish meal does not impart a fishy flavor to the meat or lard in any way if fed in proper proportions with other feeds. Where fish meal can be obtained conveniently at a reasonable price and in suitable quantity, it has a very considerable value in pig feeding. When given a fair trial and used in proper proportions it should become one of the most popular as well as most remunerative protein supplements for pig feeding.

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